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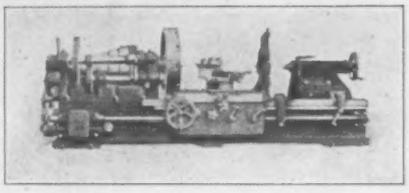

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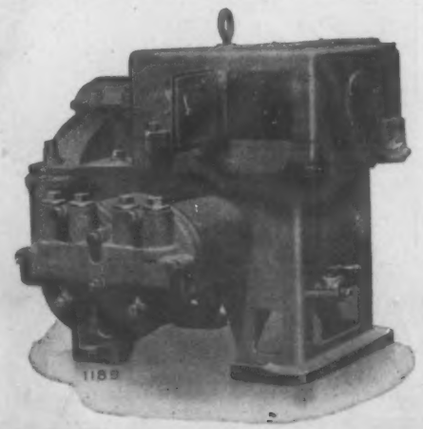

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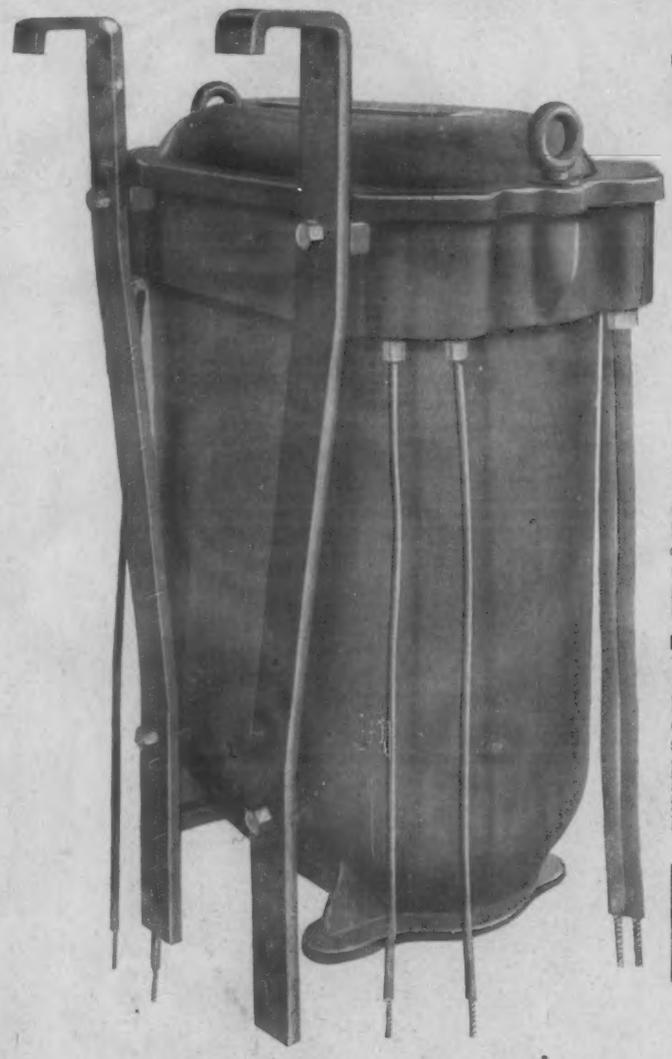

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26	3.33	22	2.72	94.	94.1	92.9	88.2	750
30	3.00	27	2.70	94.6	94.50	93.19	89.86	1000
37	2.42	34	2.46	95.4	95.41	94.28	90.50	1500
44	2.20	46	2.43	95.70	95.79	94.57	91.00	2000
48	1.92	55	2.37	96.00	96.12	95.41	92.53	2500
49	1.63	60	2.30	96.40	96.54	95.93	93.50	3000
55	1.37	82	2.27	96.67	96.82	96.31	94.40	4000
61	1.22	100	2.15	96.83	97.12	96.70	95.00	5000
87	1.16	145	1.98	97.00	97.32	97.02	95.40	7500
105	1.05	177	1.83	97.25	97.48	97.21	95.52	10000
122	.98	202	1.76	97.40	97.70	97.39	95.95	12500
134	.90	252	1.64	97.50	97.74	97.42	96.11	15000
163	.80	320	1.55	97.64	97.89	97.79	96.46	20000
187	.75	380	1.48	97.78	98.03	97.88	96.76	25000
204	.68	432	1.42	97.92	98.12	97.96	97.01	30000
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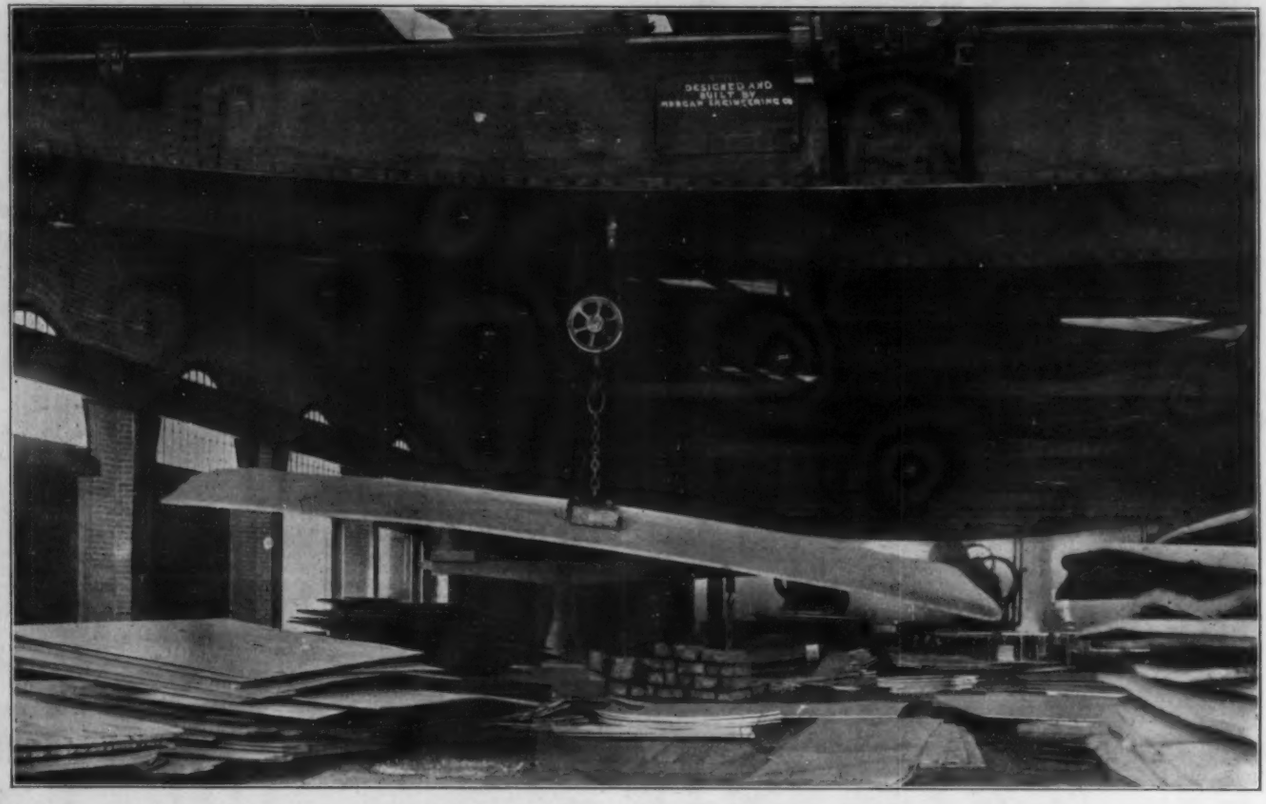
Lifting Magnets in Iron and Steel Works.

The modern electrically operated crane is one of the most practical and efficient of all the labor saving devices now utilized in the machine shop, foundry, and iron and steel plants. The electric current, besides being available for operating the crane, can also be utilized to advantage for energizing electro-magnets for lifting iron and steel castings, rolled angle iron, plates, girders, and even finished machinery.

It is very difficult in many cases to properly hold the various castings, plates and rails to the hooks of the traveling crane by ropes or chains. Lifting electro-magnets have many advantages in this respect, and permit a much greater speed of operation. The accompanying illustrations show the construction and emthod of operation of lifting electro-magnets of German, Belgin, and American design. Lifting magnets have been utilized to advantage in German iron and steel works. A method of lifting groups of angle irons in a German shop is shown in Fig. 3. It will be noticed that hooks are provided for use, to ensure against dropping the load in case the current is for any reason shut off.

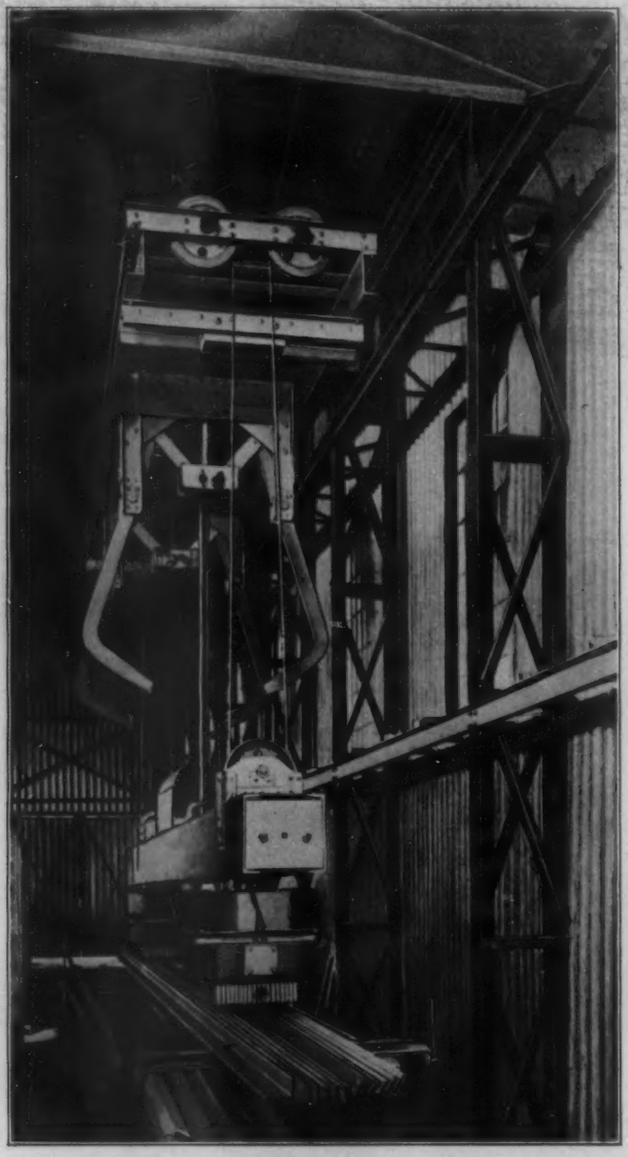
These magnets are capable of supporting a maximum load of 4,500 pounds, and the crane has a hoisting speed of 50 ft. per minute, the trolley traveling at the rate of 150 ft. per minute, and the crane operating at a speed of 328 ft. per minute. The German crane and electro-magnet equipment shown in Fig. 3 utilize a three-phase alternating current of 400 volts pressure for operating the motors, while the lifting magnets are energized by direct current at 230 volts supplied by a rotary converter, the motor end receiving the three-phase current at 400 volts, and the direct current end delivering continuous current at 230 volts to two lifting electro-magnets mounted on the same hoisting frame.



LIFTING MAGNET IN AN AMERICAN STEEL WORKS.

The construction of an electro-magnet for lifting heavy pieces of iron and steel, and the design of the same, would seem to present no great difficulties, but up to the present time, but few manufacturers have been successful in placing apparatus of this type on the market. Lifting magnets have been designed by engineers in this country especially for handling steel plates. Some of these are now in operation

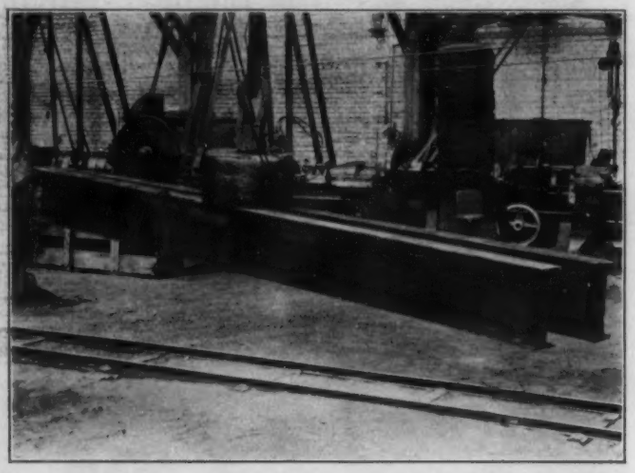
at the works of the Otis Steel Company, as well as in other iron and steel plants, and have given excellent satisfaction. Those in the Otis Steel Company's works were designed and constructed by the Electric Controller & Supply Company of Cleveland, Ohio.



GERMAN ELECTRO-MAGNET SUPPORTING A LOAD OF ANGLE IRONS.

At Liege, Belgium, at the electrical works of the Compagnie Internationale d'Electricite, lifting magnets of the type shown in Fig. 2 are constructed. The designing engineers claim a high efficiency and many superior merits for this type. It is maintained that the electro-magnet when well designed and constructed, and successfully operated, permits of a great saving in manual labor and time. Ropes and chains have always been employed heretofore for attaching the load to the hook of the crane, and this required the services of at least two or three men, on account of the heavy and awkward pieces of metal that have to be carried from one part of the shop to another.

By means of the electro-magnet, all of the operations are carried out by the attendant on the crane, entirely doing away with the ropes and the men required to fix the tackle. The crane driver simply lowers the magnet on to the piece of metal to be lifted, and excites it by closing a switch. The load is raised, swung over the desired location and lowered. The exciting circuit of the magnet is then opened, and the hook and magnet raised by the crane and moved back for the next load.



ELECTRO MAGNET IN A BELGIAN SHOP.

It is claimed by those operating this type of apparatus that a load may be picked up in an exceedingly short time, only two or three seconds being required for sufficiently magnetizing the lifting magnet. The enormous saving in time thus made allows a greater output for each crane, so that fewer cranes are required to do the same amount of work. While it is true that there is a greater consumption of power the amount of current used is not large enough to be considered an important factor. An electric lifting magnet which is capable of sustaining 2½ tons, according to the data given by the Belgian engineers, requires about 750 watts.

There are two types of lifting magnets constructed at Liege, the single and the double type, the latter being simply composed of two of the single type magnets, one fixed at each end of a beam, suspended at the middle from the crane hook. The International lifting magnet consists of two parts, the outside bell shaped cover and the magnet proper. The cover is utilized to protect the inside mechanism from any shocks which might occur, and from exposure to the atmosphere when the crane is operated in the open air. The current is supplied by two conductors placed along the length of the crane, the connection being made by contact pieces attached to the crab. Both pig and scrap iron can be handled, either hot or cold, but the design of the magnets varies somewhat with the character of the work to be lifted. The lifting magnet will, no doubt, be more extensively used in the future as the rapid introduction of electrically driven machine tools brings with it more available sources of electric power.

A GENEROUS OFFER.

In connection with the announcement of the Co-operative Electrical Development Association, offering $2,600 in prizes for material for a Solicitors' Handbook, the Holophane Glass Company state that the services of their engineering department are at the disposal of any persons wishing information in regard to the subject of illuminating engineering.

This offer will be of great value to any who intend to enter this competition, as information from the Holophane Glass Company will be of the greatest value on account of their extended experience in the field of illumination.

HIGH-PRESSURE FIRE SYSTEMS.*

By F. L. Hand.

The question of having an adequate water supply for conflagration purposes was fully impressed on the city of Philadelphia by the action of the board of underwriters in the year 1900. The insurance companies at that time increased the rates twenty-five cents per one hundred dollars insured on all risks in the district where are located the large wholesale and retail stores and office buildings which one is apt to find in the congested business district of a city numbering one and one-half millions of inhabitants. The increasing of the rates of insurance twenty-five cents per hundred dollars naturally raised a stormy protest from the business men, and the matter was immediately taken in hand by the Trade League, a committee of which waited on the underwriters to learn the reason for the increased rates. The underwriters replied inadequate water supply and fire-fighting inefficiency.

Both bodies recognizing this, waited on the Mayor with a proposition that if a more efficient fire service could be had the underwriters would bring their insurance back to the old rating. The Mayor of the city, feeling the hardship of such an increased rate made upon the business community, immediately instructed me, as Chief of the Bureau of Water, to devise a method of water supply for conflagration purposes that would be effective in not only reducing insurance rates but increasing the efficiency of the fire department, so as to enable it to cope with large conflagrations for all time to come, that is to say, be adequate enough to keep pace with increased size and area of new structures.

The Problems Involved.

In considering this proposition the main problems to be solved were: First, an independent pipe service entirely free from any connection with the existing distribution system. Second, the use of raw water for conflagration purposes. Third, a power plant independent of any other pumping plant in the water department, and such a power plant being called on intermittently for service, required for economical operation that the usual stand by losses be eliminated. Hence the motive power—steam, gas or electricity, had to be considered along economical and assured lines. Fourth, the standard of efficiency in fire department equipment and management had to be correspondingly increased to meet the new conditions of a 300-pound working pressure, which was to be maintained without diminution as long as required. Fifth, the combined high-pressure system should be equivalent to twenty of the best steam fire engines in the Philadelphia fire department, the same to be rated with a pumping capacity equal to five hundred gallons per minute.

Comparison of Different Systems.

The whole subject of fire protection by high-pressure pumping stations is so new, and the conditions so different to any other service, that in making comparisons between various systems the ordinary arguments for and against have little application, and must be regarded from an entirely new viewpoint. For example: In the ordinary power plant, whether used for pumping, lighting, car service or manufacturing, low cost of operation during use is the most important consideration, since this is the normal condition of the plant. In fire service this really is of small account, since the normal (and ideal) condition of the plant is standing idle, but ready for use at any moment.

The reverse is equally true, the cost of maintenance while standing idle is of small account to the ordinary plant, but is the chief item in a fire service station.

*From a paper presented to the American Water Works Association, Boston, July, 1906.

Similarly, while certainty of starting and of operation is desirable in the ordinary plant, they are absolute necessities in fire service, and a pumping station which is liable to be ten minutes late in starting or to stop for half an hour while running, might as well, in fact, better, not be built at all, since dependence upon it would lead to the neglect of other precautions.

Wear due to operation is of great moment in the ordinary plant, while in the fire station it is of little importance, owing to the low total running hours, but non-liability to accident is a large factor with the fire service, since its infrequent operation gives none of that opportunity to detect gradual deterioration or misadjustment which constant running gives in the ordinary plant. Comparisons based on the first cost, too, require absolutely new treatment, owing to the entirely different conditions governing depreciation and replacement. Considering the subject in this way we may set the various requirements of a high-pressure pumping station in the following order of importance:

Certainty of starting promptly on call.
Certainty of operation when started.
Low first cost of maintenance when standing idle.
Low liability to depreciation or accident when standing.
Low first cost.
Low cost of operation when running.

Three systems are open to any place in considering high-pressure pumping plants: First, steam pumps and boilers. Second, electrical-driven pumps taking current from a central station. Third, gas engine-driven pumps.

The usual condition in which a steam plant is considered to be ready for instant service is either with fires laid in quick-steaming boilers or with fires banked and some pressure on in ordinary boilers; to be truly ready, the boilers must have steam up, fires burning freely, and engines or pumps hot and turning over slowly. This entails prohibitive expense. It may be argued that this may be done where a city has a steam pumping plant for its ordinary service, but this I shall discuss under the head of electric drive.

Steam machinery may be considered reliable in operation dependent on the usual limitations of stuffing boxes, piston rings and steam pipe lines with their joints, drip valves, etc. Steam machinery costs almost as much to maintain when standing idle as when operating regularly. It must be run constantly or the rings and internal parts will rust, and perhaps stick fast, and a few days' rust scraped off will equal many weeks' honest wear, besides the fact that all damage is done internally where it is difficult of access for examination.

A pump driven by electricity from a central station is a very tempting proposition, especially as local companies will often make very low offers for power for such a purpose. In the case of sewage disposal, or the like, where the power will be used wholly or chiefly during the hours of light station load, such an offer is a legitimate business proposition.

The idea that by closing a switch the power is instantly available is most enticing, but it must be remembered that electricity is not a generator of power, but only a means of transmission, exactly as a belt or rope is, and the limit of power which a central station can furnish on sudden call is the actual surplus boiler, engine and dynamo capacity in use at the moment of alarm.

In other words, to be fully fitted for an electric-driven station the electric company would have to install, in addition to its regular plant, boilers, engines and dynamos to 25 per cent. greater capacity than your pumping plant, and keep this apparatus under constant steam ready for use. No company will do this except for an enormous rental or maintenance charge, and, if they would, it would be simpler and cheaper for one to install a steam plant and save the cost of the electrical conversion of energy.

For reliability of operation of electric pumps I can only refer to the liability of interruption of service. The safety

devices required for the protection of the central station machinery are the danger devices which may cut off your supply at any minute or instant, and the fire which you are fighting may disable the overhead lines which supply your power. Even in Philadelphia, with its many stations, and all underground electric mains, in the two years of operation of the high-pressure pumping station the one failure of any part has been the interruption for half an hour of the ignition current from the Edison mains. As we equipped the station with three different methods of ignition this caused no trouble, but it is suggestive that the only failure of any part should be the outside electric current.

Every failure of lights, every stoppage of the trolley cars, means that this might happen to a fire plant, and if these happen on an apparatus which is a part of the regular and daily operation of the station, what would it be when you throw on them without warning from 200 to 1,000 horsepower? If there is any class of machinery subject to depreciation in an unseen and undetected way it is motors and dynamos. So thoroughly did we recognize this in the Philadelphia plant that in using electric ignition we installed no fewer than three independent methods and congratulate ourselves that the only one which has ever failed, failed outside the pumping station.

Reliability of Gas Power.

Compare with this the gas engine driven pumps as installed by us in Philadelphia. In over two years of actual service, including alarms of fire, several of the most exacting tests by the city officials and experts from the underwriters, and constant runs for training and practice of attendants, not once has any one single unit failed to get full pressure on the mains in less than one minute, actual timing.

The average time is 40 to 45 seconds, the record time 27 seconds from the time the alarm sounded, with a further record of nine engines started and pumping 10,000 gallons per minute in less than 7 minutes; the whole being done by the regular crew of one engineer and two oilers.

No unit has ever stopped during a run, and before the plant was accepted one unit was taken at random and run overload for twenty-four hours without a moment's stop and when shut down the oil cups were simply shut off and the engine reported ready for duty. The only thing which can affect the Philadelphia station would seem to be a failure of the gas supply. I am not prepared to answer for other localities, but in this city there is no recorded failure of gas supply in forty years.

The gas engine and pump cost nothing when not running, the instant you do not need them the closing of the gas valve cuts off fuel expense. No banked fires, no wasted coal or oil, no steam pipes to watch, only the wages of the men to pay, and the slight charges for waste, etc., to keep the plant clean. I canot offer a better argument than the Philadelphia plant. It has converted the underwriters from opponents of the gas engine proposition into its warmest advocates. And Philadelphia has the honor of being the first city in the world to establish an independent central power station for use as a fire fighting medium only.

The high pressure fire pumping station was put into service under the jurisdiction of the Department of Public Safety February 15, 1904, on which date the fire boats were discontinued as a source of water supply to the special pipe lines.

As the mechanical installation called for a guarantee of one year after completion by the contractors, steps were immediately taken to carefully try out all the mechanism under various loads and conditions, these tests applying to every engine and pump. These tests, coupled with actual service since erection, have more than demonstrated the value of a central power station as a fire fighting medium, and exceeded the expectations of every one connected with this new fire service.

The completion of the fire main pipe lines resulted in a reduction of insurance rates amounting to fifteen cents per hundred dollars, with an additional proviso on the part of the Philadelphia underwriters that a further reduction of ten cents per hundred dollars would be made upon the entire completion of the pumping station, making in all a total reduction of twenty-five cents per hundred dollars—whilst the pumping station and completed pipe lines were turned over to the Department of Public Safety for active service on February 15, 1904, it was not until April 19, 1904, that the full reduction in insurance rates (mentioned above) was allowed by the underwriters.

Test Required by the Underwriters.

At first the underwriters were adverse to the reliability of the gas engine as a means of motive power, and they demanded a test before their experts before accepting the plant. With this idea in view, they furnished me with a routine of operations which they desired the plant to fulfill, and are as follows:

(1) The station shall be started and run with the smallest number of men who ever would be on duty at a given time, and the reliefs shall be allowed to come on duty as they would in actual service.

(2) The minimum time of operating all the engines shall be twelve hours (not necessarily consecutive hours) for all engines, slight breaks being allowed for observation of results, but such twelve hours shall be the sum of the run times of the mean number of engines under operation. All times when the engines are at rest due to the shutting off of nozzles, shall not be considered running time. In fixing this time we desire to note that a serious conflagration might demand continuous use of the station for 24 or 48 hours, and that a 12-hour run does not seem to us more than might be called for under conditions which are liable to prevail at any time.

(3) The water discharge shall be from two separate stations on Delaware Avenue, the location of such stations to be determined by the city authorities, and the tests shall be made through orifices of a known size and construction, so that the actual discharge can be computed from tables already in our possession, this discharge to be maintained at a minimum pressure of 250 pounds per square inch at the pumps.

(4) The engines shall be started in such a way as to demonstrate whether or not the capacity of the air storage is sufficient to start all the engines under the most adverse condition, and as the test of starting under actual service conditions, one engine shall be started up under load so that it is discharging water at a maximum pressure within two minutes, the second shall be started in six minutes, the third in twelve minutes, and each additional engine in ten minutes.

(5) From the time at which the preceding engine was started, all engines to be kept in operation until all are started and as long therafter within the 12 hours as may be thought advisable by our committee.

The plant fulfilled the most exacting conditions, and this even under the operation of a staff whose experience at that time with the mechanical equipment had not reached the standard of efficiency existing at the present day.

The entire plant was operated from 6 a. m. to 3:30 p. m., with one unit running continuously 12 hours, 6 a. m. to 6 p. m. The entire pipe service, nearly nine miles, was subjected to the maximum pressure of 300 pounds per square inch for a period of four hours without a defect showing. The entire installation has more than fulfilled the conditions projected by the city authorities and contractors, the plant representing the largest installation of gas engines and the only central power station of its character in the world.

Working Out the Details.

In considering the pipe system, much care was exercised. Steel flanged pipe, cast iron flanged pipe, and extra heavy bell and spigot pipe all received careful study, along all lines. The available appropriation would not permit the use of steel mains; its cost was excessive compared with the use of cast iron. Bell and spigot pattern of cast iron pipe was abandoned, owing to the multitude of lead joints, thus increasing the liability to leakage through bad caulking of joints, or through such a pressure as 300 pounds per square inch. A decision was finally made in favor of cast iron flanged pipe with a solid lead sleeve introduced every 250 feet. In adopting this I feel we have used good judgment, as we have not had one defect develop in the entire 8½ miles of pipe system since it was put into service, three years ago.

The entire system has been subjected to a pressure of 300 pounds per square inch a great many times, in some cases for a steady period of five hours, and again is constantly subjected to pressures varying from 50 to 300 pounds at almost all conflagrations, dependent on fire department manoeuvers, increasing or decreasing the lines of water in service, etc.

In designing the pipe service provisions were made for three fire boat connections along the Delaware river front, and six ways of circulating water, together with the introduction of many valves, so that in case of accident a minimum amount of the service would be thrown out of commission. Again, in laying the service a minimum depth of 7 feet was adhered to, the idea in this being to get below all service connections into buildings, etc., thus placing ourselves beyond disturbance in this direction. At the same time it gave us solid ground for pipe laying.

The three fire boat connections act as a relay water supply to the pipe system, which is entirely independent of the pumping station. All sleeve and valve boxes are built large enough to permit any work in connection with sleeves or valves to be done without tearing up the street.

All pipes and fittings were subjected to a pressure of 800 pounds per square inch (water) before accepted at the foundry, then when laid all pipes were again subjected to a water pressure of 400 pounds per square inch to test accuracy of bolt joints and caulking on sleeves, stuffing boxes on valves and connections to hydrants, etc.; the portion of the line thus tested was then filled in and the ditch repaved.

Drilling the Fire Department.

As soon as the high pressure system was finished the fire department was taken in hand in order to drill the men under the new order of things, and likewise test all the appliances, such as hose, nozzles, couplings, etc. A series of tests were given every week with water thrown into the river opposite the pumping station. These exhibitions were made to make the men of the fire department familiar with this new fire-fighting medium, and in making these tests it was found that the old-time method of handling hose nozzles in throwing a stream of water where maximum pressure from the average steam fire engine rarely exceeds 125 pounds, would not answer at all for the new pumping station, with its delivery and pressure maintained at 300 pounds per square inch; hence to invite the confidence of the firemen in the use of high pressure streams, Mr. John W. Weaver, the constructing engineer of the high pressure system, designed a water battery capable of taking care of any pressure the station is capable of putting on the pipe lines. This battery has completely solved the problem of handling hose nozzles under all pressures, and has given much satisfaction in the fire department. For low pressure use an ordinary stake with steel prongs is used. Mr. Weaver then turned his attention to the quality of hose, couplings, nozzles used in the fire department, and has made tests lasting through an entire year, the result of which has been to increase the efficiency of the entire department. Mr. Weaver, on the strength of these tests, has issued a specification on which the fire department equipment has been purchased for this year.

The prices of the successful competitor were 75 cents per foot for 2½-inch hose, and $1.40 per foot for 3½-inch all cotton rubber lined hose and guaranteed for four years. In addition to the above, Mr. Weaver is at present testing the merits of cotton versus rubber hose in the department, the results of which cannot as yet be determined.

It will thus be seen from the above that a high pressure system is likened to a well organized army. For instance, the artillery is the pumping station, the cavalry the pipe line system, and the infantry the fire department. Therefore, as a chain is no stronger than its weakest link, so all three branches of service for successful operation must necessarily reach a high grade standard of efficiency.

Future of High-pressure Fire Systems.

I believe it to be only a question of a few years when the steam fire engine will be abandoned in large municipalities, and central power station system will be in advance. Even in small towns this is absolutely possible and economical with the use of the gas engine working with illuminating gas, gasoline, or by aid of a producer. Of course a gas engine is not a commercial possibility when operating on illuminating gas at $1.00 per M., and running 8 or 10 hours every day. It is, however, possible with the aid of a producer, or natural gas.

There are today numerous small towns throughout the United States that should consider with favor the gas engine proposition with a view towards a combined distribution and fire system, procuring their water supply from artesian well system. Take, for instance, small towns of from 3,000 to 5,000 inhabitants, with the artesian well system. Two gas engines of 50 horsepower each attached to pumps could readily and very economically fill a stand pipe 125 feet high by 30 feet in diameter, and maintain an efficient supply by operating only 12 hours out of the 24 hours as is usual with steam plants and far more economical; the stand pipe system alone furnishing supply and pressure fully ample to take care of distribution. The supply to stand pipes being cut off in case of conflagration, a 100-pound pressure can be obtained for fire purposes directly through the distribution mains. Such a problem could readily be solved and be economical, as it would dispense with the steam fire engine and render at the same time more efficient service.

The Philadelphia pumping station, as before stated, was to equal in capacity twenty steam fire engines with a capacity of 10,000 gallons of water per minute. We have done this at a cost of $177,000, and what is better still, we maintain it annually for two thousand dollars less than it costs to maintain one fire company of 12 men.

Pumping Station Staff.

The pumping station staff consists of a superintendent, two engineers, two oilers (one engineer and two oilers 24 hours on and 24 hours off), one mechanic (8 hours daily), a janitor (10 hours daily). Each engineer keeps a daily log, the records taken being: (a) reading gas meters three times a day; (b) pump counter readings three times a day; (c) pressures and temperatures three times a day; (d) electric light and power meter three times a day; (e) alarms, services and general occurrences.

Every day the following tests are made: (a) electric currents; (b) cleaning and trying out ignitors; (c) general examination of engines and pumps; (d) individual engines turned over for 5 to 10 minutes' run. Engines and pumps are cleaned daily. The entire plant is turned over once a week. Every ignitor is cleaned once in three months. The three ignition currents are tried before and at every fire service. The air is always pumped up immediately after starting the first engine.

Operation of the Plant.

The entire station is put under way in 7 minutes.

The full pressure on pump, 300 pounds, is obtained in 45 seconds.

The average starting time, per unit, is 1 minute.

The compressed air starting system is fully adequate.

Each compressor is able to run one large engine continuously, independent of the storage tanks.

The total air pressure drop in starting nine units, with the compressor out, is 97.9 pounds average, initial 200 pounds.

The time required to place on ignitor is 4 minutes.

The gas supply is clean, uniform and continuous.

The cost of power is approximately proportionate to pumpage.

The total operating cost averaged 12½ cents per 1,000 gallons pumped.

The cost at a large fire is 6 cents per 1,000 gallons pumped.

The entire plant is capable of supplying fifteen 1½-inch streams that may be concentrated on any block within the congested or protected district.

A special battery wagon provided can handle six 3½-inch lines of hose.

The average station pressure for an ordinary fire is 200 pounds.

The pressure drop in 3½-inch hose is about 20 pounds per 100 feet.

INTEREST IN IMPROVED METHODS OF ILLUMINATION.

The recent remarkable growth of interest in the subject of illumination is well exemplified by the rapidity with which the movement throughout the country has spread. Naturally, at the start the subject of better illumination was taken up in the large cities, but the smaller places have in many instances not at all been behind the larger places in the endeavor to give the customer better illumination, and, therefore, better satisfaction for the same expenditure of energy. So rapid has been this growth that the lamp companies find it impossible to fill the orders for the latest types of lamps of a higher efficiency than the old carbon types. As an example as to showing how the movement has spread to the smaller towns, may be cited the case of Middlebury, Vermont, a small place of only 1,900 people. This town, under the efficient management of Mr. C. C. Wells, secretary and manager of the company, has perhaps some of the best lighted stores that can be shown anywhere. It is using a very large number of the Gem lamps equipped with proper Holophane reflectors, so that today the store lighting of this small place is on the average much superior to the larger cities. The movement is spreading so rapidly in the town that the management find it impossible to keep pace with the same.

It is interesting to note the attitude of a small place like this compared with the attitude of similar towns a few years ago before the movement toward better illumination had started. At that time, a store was sufficiently well lighted if a number of bare incandescent lamps were hung by drop cords in different parts of the store, allowing the bare lamps to glare in the eye of the customer, as they were placed only slightly above his head, lighting the ceiling fully as well as the counter. Today this attitude has materially changed, and the electric light companies are endeavoring to educate their customers to the difference between light and illumination, which results so materially to their benefit, as the customer ultimately uses more light, gets better illumination and becomes a satisfied instead of a dissatisfied customer.

PROGRESS OF ILLUMINATION IN 1906.

"Never has greater interest been displayed in new methods of electric illumination than during the past year," says the "Scientific American," in the review of technical and scientific progress for the year 1906. "If the promises which are held out by the inventors of metallic filament lamps are fulfilled we may soon witness the passing of the carbon filament bulb. Although the Nernst lamp, on which great hopes were based because it requires only half as much current as the carbon filament, has proved too costly, and the osmium lamp has been found wanting for the same reason and for the additional reason that its voltage of 47 is too low for ordinary circuits, the tantalum and tungsten lamps seem likely successors of the standard incandescent lamp. The tantalum consumes about as much energy as the osmium lamp, but its long filament renders its use possible on a 110-volt circuit and on circuits of even higher voltage. Its useful life of 400 to 600 hours and its maximum life of 1,000 hours and more compare favorably with those of the best electric incandescent lamps in use. The filament is very delicate but able to stand greater variations in voltage than the carbon filament. When broken the ends readily fuse, so that the tantalum lamp's usefulness, although impaired, is not utterly destroyed. The present low cost of construction (about 50 cents), coupled with its high voltage, give it a decided advantage over the osmium filament. Guelcher's iridium lamp is made only for low tensions (24 volts); it consumes, it is claimed, only 1 to 1.5 watts per candlepower, and costs about 87 cents. What its life may be it is impossible to state, inasmuch as no figures have been published. It is open to many of the objections leveled at the osmium lamp. More promising is the tungsten lamp, which is now made by four European firms using as many different processes. The normal tungsten lamp of Just and Hanamann seems to give about 30 to 40 candles at 110 volts and consumes 1.1 watts per candle. Kuzel's tungsten lamp is said to show an efficiency of 1 to 1.25 watts per candle for 19 to 32-candle lamps, with a useful life of 1,000 hours, at the end of which the loss in candlepower is said to be but 10 or 15 per cent. When broken the filament automatically welds together as in the tantalum lamp. The Osmium tungsten lamps have shown from 54.7 to 55.6 candles and from 1.026 to 1.047 watts per candle at 110 volts. Whether these new lamps will fulfill the hopes placed in them can, of course, be determined only by thorough tests under conditions approximating those of actual service. At present the metallic filament lamp is in its experimental stage. The necessity of using the tungsten lamp in the inverted vertical position may perhaps be regarded as a defect; yet quite recently the vertical incandescent gas mantle has invaded an extensive field hitherto monopolized by the electric light."

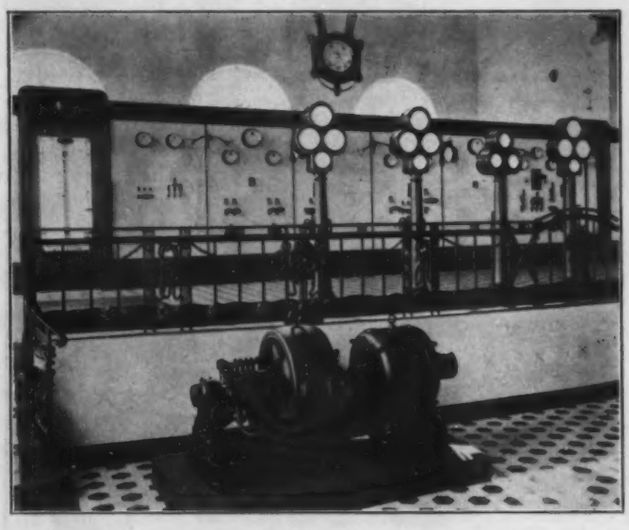
AMERICAN STEEL TRADE.

Never, either in America or elsewhere, has there been such an extraordinary condition as that in the steel industry of the United States. The mills are already crowded with orders to such an extent that their total output up to the end of 1907 will barely serve to represent the demand; and the mills which are devoted to the production of structural steel are overloaded with work and must be pushed to the very utmost to fill orders that are due to be delivered in the coming Spring. Even more urgent conditions prevail at the plate mills, the demand for whose output is to be attributed very largely to the growing popularity of steel cars. These mills have sufficient orders on their books to keep them going at full pressure for practically the whole of 1907. Nobody would have predicted at the time of the formation of the United States Steel Corporation a few years ago that within so short a time not only that great aggregation, but also the independent concerns, would be taking orders for materials which could not possibly be delivered for twelve months or more from the date of signing the contracts.

ELECTRICITY IN THE OPERATION OF THE TELTOW CANAL.

In Germany canal towage by electricity has recently been demonstrated as commercially successful, particularly on the Teltow Canal near Berlin. The further application of electricity to the navigation of inland waterways is considered most desirable. The Teltow Canal is 23.5 miles long, and connects the river Spree with the Havel at Glienicker Lake. At the river Spree about nine miles from Berlin, near Drunau, the canal starts with a width of sixty-eight feet and a depth sufficient for canal boats drawing nearly six feet of water and having 1,200,000 pounds register. The boats usually employed on this canal are 110 feet long and 8.6 feet wide. The canal has a depth of eight feet at low water in the middle and seven feet at the sides.

Between the Havel and the Spree there is a difference of level of about ninety-seven feet and a system of locks has been installed about five miles from the Havel, consisting of two locks placed side by side with a wide masonry wall between them. A system of conduits has been provided within this wall for filling and emptying the locks with a minimum amount of water, the arrangement being such that the water used by a boat going down the canal may be emptied into



SWITCHBOARD AND EXCITER SET AT THE CENTRAL POWER STATION OF THE TELTOW CANAL.

the other lock for raising a boat going in the opposite direction. During the dry season, water is pumped from the lower to the higher level by means of a centrifugal pump, electrically, operated, having a capacity of one cubic meter a second. There are four hoisting gates at the locks, each of which is operated by a 15-horsepower motor, running at a well as the equipment for supplying the necessary curspeed of 600 revolutions per minute. These electric motors, as rent, were installed by the Siemens-Schuckert Company of Berlin. The motors are of the three-phase induction type, operating at a pressure of 200 volts; and can raise the gates to their full height of 8.27 meters in one minute. Electromagnetic brakes are provided and the gates are counterbalanced with variable weights, the electric motors being employed for both hoisting and lowering.

During high water it is necessary to conduct a portion of the water from the higher to the lower level, and this is done by means of a gate in the middle wall, operated by an eight-horsepower induction motor running at a speed of 580 revolutions per minute.

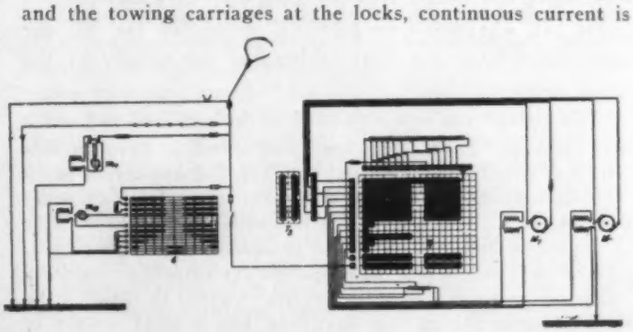
The power station of the Teltow Canal is equipped with a 300-horsepower reciprocating engine installed at that end of the station nearest the switchboard, together with two steam turbines of the Zoelly design, constructed by Escher Wyss & Company, of Zurich, Switzerland. Each of these turbine units consists of a high-pressure and a low-pressure turbine, provided with five runner discs, and can develop a total of 1,000 horsepower. The capacity of the plant is therefore 2,300 horsepower. Space has been provided for other units to be added as additional power is required.

The reciprocating engine is coupled to a large revolving field alternator and a multi-polar direct current dynamo on the same shaft. Each of the 1,000 horsepower steam turbines is direct-connected to a three-phase alternator of the revolving field type, generating at 6,000 volts at a frequency of 50 cycles per second. On the same shaft of each is mounted a Siemens-Schuckert compound-wound, direct-current dynamo, of the inner-pole type, supplying continuous current at a pressure of 600 volts. The alternators driven by the steam turbines have a rating of 650 kilowatts, and the one driven by the reciprocating engine, a rating of 230 kilowatts. The direct-current machine connected to the engine has a capacity of 110 kilowatts, while the two continuous-current turbine driven dynamos have a capacity of 200 kilowatts each.

In connection with the steam turbines, jet condensers are employed and three-phase motors are utilized for driving the pumps. A vacuum of ninety-five per cent. is maintained, as there is plenty of condensing water. Steam is supplied to the high-pressure turbine at a pressure of 180 pounds per square inch, and is superheated to 300 degrees centigrade. There are four water-tube boilers, each of which is provided with a superheater which can be utilized or not, as desired, the latter having a heating surface of sixty-five square feet, supplying 8,000 pounds of superheated steam per hour. Each of the boilers has a heating surface of 2,200 square feet, and supplies steam to the turbines at the rate of 13.4 pounds of steam per horsepower hour, this being the consumption of the 1,000 horsepower turbine unit at full load. At half load the steam consumption is increased to 15.6 pounds. At three-quarters load the consumption is 14.3 pounds.

Near the end of the Teltow power station, opposite the switchboard, are located the exciter units which consist of three-phase induction motors direct-conncted to shunt-wound direct-current dynamos rated at 32 kilowatts, supplying the exciting current at 65 volts. The three-phase induction motor of each exciter set is supplied with alternating current at 230 volts, and drives the generator at a speed of 960 revolutions per minute. A storage battery has also been provided for lighting the station and exciting the alternator fields when desired, or in case of emergency. This accumulator plant consists of 36 storage cells, each having a capacity of 126 amperes for a period of half a n hour. In this station there is an overhead traveling crane of sixteen and one-half equipped with two rotary converters each having a capacity tons capacity. At the eastern end of the canal a substation has been provided which is equipped with two rotary converters each having a capacity of 150 kilowatts and operating at a speed of 1,000 revolutions a minute. Space is also provided for a third unit to be installed when desired.

For the operation of locomotives towing the canal barges, and the towing carriages at the locks, continuous current is



LOCOMOTIVE CONNECTIONS.

utilized, while alternating current is used for lighting purposes and all auxiliary work.

Various types of engines, motors and hauling methods have been tried on this canal. A 60-horsepower Daimler alcohol motor was placed in one of the boats and was found to take .01 kilogram of alcohol per ton-kilometer (0.035 pound per ton mile). This would result in a cost per ton kilometer of one-twentieth of a cent with alcohol costing five cents per kilogram (.08 cent per ton-mile).

With oil-fired boilers and a steam engine, the cost of operation when towing two boats with a load of 2,400,000 pounds and a speed of two and a half miles per hour, would be .01 cent per ton-kilometer (0.16 cent per ton-mile) with oil costing less than a cent per kilogram. A steam oil-fired boiler tug was found to take 1.1 pounds of fuel oil per horsepower hour, the boat taking 100 horsepower at the speed above mentioned.

An electric tug was also tried at the speed of two and a half miles per hour. The boat was found to have an efficiency of twenty-two per cent., the energy consumption being nine kilowatt-hours per ton-kilometer (14.5 kilowatt-hours per ton-mile). This boat which was called the "Teltow," was of the triple-screw type and was provided with a storage battery of 220 cells, having an output of 244 ampere-hours for a five-hour discharge. The battery was located in three of the six compartments of this boat, and had a total weight of 26,000 pounds.

Each of the three propellers was provided with a direct-current series motor, connected to the shafts by a flexible coupling. The three motors were placed in one compartment. The motor driving the center shaft had a capacity of 25 horsepower and ran at a speed of from 300 to 500 revolutions a minute, while the two motors driving the side propellers developed 20 horsepower each.

For collecting the current to supply the motors of the electric tug double trolley poles were tried but were not very successful. The Lombard Gerin motor-driven trolley was also used, which gave better success, although it was noted that the trolley-collecting motor would tend to lag behind when the boat was operating at full speed under a light load, while it would travel in advance of the tug when several heavy canal boats were being towed. On account of the high cost of operation and low efficiency, the electric tug was given up in favor of a locomotive towing the boats from the side of the canal on a specially constructed track.

STEAM TURBINE, CENTRAL POWER STATION OF THE TELTOW CANAL.

The Siemens & Halske canal locomotive was designed to operate on a track of one meter gauge, hauling two loaded canal boats of 600 tons each at a speed of 2.5 miles per hour. This locomotive was found to require an energy consumption, at the above speed, of 5.5 kilowatt hours per ton-mile, while with a speed of 3.1 miles per hour, the energy consumed was found to be 8.5 kilowatt hours per ton-mile. It is stated that the mean efficiency of the locomotive was sixty-five per cent.

This electric canal haulage locomotive is provided with a four wheel truck, equipped with two 8-horsepower electric motors of the series direct current type, and a trailing pair of wheels supporting the rear end of the locomotive with the guide arm and drum for the tow line. The hauling motors are connected by two sets of gears to the axles, operating at a speed of 800 revolutions a minute, with a terminal pressure of 500 volts. The guide arm for the tow line is manipulated by a 3-horsepower motor connected with a screw to the arm through a pair of bevel gears. This motor operates at a speed of 1,460 revolutions per minute, and is also used for driving the drum which winds up the towing rope, consisting of a 10-millimeter wire. The coupling of the drum is of the friction type, so arranged that when a pull of 2,500 pounds is exceeded, slipping will occur. Therefore, when starting a heavy load, the locomotive will take its load gradually, as the drum will slip until it is partially under way.

The locomotive weighs 16.5 tons. The greater part of the weight is carried by the wheels on the side toward the land, there being 4,200 pounds for each of the driving wheels, and 2,700 pounds for the trailing wheel. On the side toward the canal, the weight on the trailing wheel is 850 pounds and on each driving wheel 3,000 pounds.

The arrangement of the weight of all the auxiliaries on the side of the locomotive away from the canal, as well as the placing of the driving motors as far as possible on that side, is on account of the tendency of the pull on the tow line to tip over the locomotive. In order to overcome this to a still greater degree the rail on the side nearest the canal is raised somewhat higher than the inner rail.

For handling the boats at the locks a trestle construction was built, extending 455 feet along the middle of the canal and provided with two parallel tracks. Electrically-operated crane cars, each weighing 3,300 pounds, run on these tracks and haul the boats into and out of the locks. The motor equipment is sufficient to haul a boat in a half hour from a point about 350 meters from one end of the lock to an equal distance at the other end. The two locks can be operated at the same time with two boats in each lock, thus giving a maximum tonnage of about 65,000 in twenty-four hours.

OPERATION OF A ROTARY CONVERTER SUB-STATION.

In an address delivered before the Western Society of Engineers, Chicago, Dec. 21, Mr. Ernest F. Smith discussed the operation of a rotary converter sub-station from a practical point of view. Among his remarks were included the following:

Brush Economy.

The question of brush economy is one of extreme importance, especially when considered in connection with the operation of a large system, such as that of the Chicago Edison and Commonwealth Electric companies. In these systems there are in operation about 70 rotary converters and when we consider that the cost of a complete set of brushes for a rotory converter ranges from $40 for a 500-kilowatt machine to $180 for a 2,000-kilowatt machine, which means that the cost of brushes only of the converters in operation in the system mentioned is slightly in excess of $4,000, it will readily be seen that brush economy is quite an important subject.

This matter has been given a good deal of careful study and by careful attention to systematic maintenance of brushes, commutators, and collector rings, the life of a set of direct-current brushes has been increased until it is from four to five years at the present time. This figure include. wearing out and destruction of brushes from all causes, including the wear on commutator, sanding, cracking due to vibrations, explosions due to rapid expansions and burning off of pigtails or unsweating of pigtail caps due to poor contact or defective distribution of load between brushes.

Considering wear and loss due to sanding only, the life of a direct-current brush is equivalent to about eight years, and considering wear only the life would be about ten years for an alternating-current copper brush and twenty years for a carbon brush. It will thus be seen that, considering twenty years as the maximum possible life and four years as the actual life obtained in practice, that the percentage of life in the Edison and Commonwealth systems is about 25 per cent. This is considered to be comparatively high.

Setting Brushes.

There are 430 brushes on a 2,000-kilowatt machine and 112 on a 500-kilowatt machine, necessitating constant care and attention in order to keep them in prime condition. The matter of properly setting the brushes is of the utmost importance. The brush-holder studs on the direct-current side should be accurately and equally spaced all around the commutator and a line of brushes of a given polarity across the commutator should be absolutely parallel with the commutator. The copper brushes on the alternating-current side studs should be staggered with reference to each other, so as to cover the entire commutator surface, instead of allowing the brushes of a given polarity to track and form grooves.

Experience indicates that a carbon brush tension of about 1 1-3 pounds per square inch gives most satisfactory service and contributes to the life of the brush and commutator. The copper brushes on the alternating-current side give very satisfactory results when the tension is from 1½ pounds with a 500-kilowatt to 2 pounds with a 1,000 or 2,000-kilowatt unit. The current density in the contact surface of the rotary-converter brushes in use in the system referred to ranges from 27.6 amperes per square inch for a 500-kilowatt rotary to 33.3 amperes per square inch for 2,000-kilowatt rotary on the direct-current end and from 50 to 57 amperes per square inch for the laminated copper brushes on the alternating-current end.

The equivalent of one complete row of carbon brushes is treated with dynamo oil and distributed in the brush holders throughout the commutator in such a manner as to bear on the entire commutator surface. This is for the purpose of effectively lubricating the commutator, thereby reducing friction and noise in operation. The method of treatment consists of immersing the carbon brushes in boiling oil for a period of about an hour, after which they are removed and dried at a temperature of 200 or 300 degrees F. for a period of half an hour or more. The commutator surface is frequently wiped with a clean piece of cheesecloth, and when the machine is about to be shut down and is well heated up a piece of cheesecloth bearing a trace of oil is wiped across the commutator, with a clean, dry piece of cheesecloth bearing upon the commutator surface immediately back of the oiled cloth. This method of maintenance will keep the commutator and brush surfaces in good condition.

The alternating-current brushes are staggered on the ring, so as to get an even wear and it is found with good care that it is not necessary to retrim them or seriously disturb their adjustment more frequently than about once a year. They are then properly trimmed and beveled and replaced on the machine. A very light application of vaseline or machine oil from time to time, while the machine is in operation, will effectively prevent cutting of the ring or excessive wear on the copper brushes. This treatment will preserve the commutator and collector rings in good condition, requiring the turning down of the collectors at intervals of about five years, and turning of the direct-current commutators at intervals of from five to ten years. As the cost of turning down commutators and collector rings ranges from $58 for a 500-kilowatt machine to $140 for a $2,000-kilowatt machine, it will readily be seen that there is room for substantial saving by the proper care of these parts.

Oil Economy.

In connection with oil economy statistics show that the average consumption of oil for each machine in the system during the past year has been 3.2 gallons. This is equivalent to a life of four years for the oil. The temperature of the bearings is very closely observed with reference to the temperature of the surrounding air, and in all cases where the rise in temperature exceeds 15 degrees C. the oil is promptly filtered and replaced in the bearings. This will usually result in lowering the temperature. If the temperature still remains high the cause is further investigated and removed.

The average rise in temperature of all bearings in the Edison and Commonwealth systems at the present time is approximately 14 degrees C., the minimum being about 7 degrees C. A portable filter is used for the purpose of filtering oil and is sent from one substation to another as required.

Blowers.

It is extremely important that the condition of the blower equipment for the air-blast transformers and regulators be properly maintained at all times, as the shutting down of the blower would seriously affect the operation of the converter units at times of heavy load, and on account of the serious overheating of transformers and regulators which would follow, it would soon become necessary to shut down the main units if the air blast were not restored.

The screens used for cleaning the air are regularly inspected and washed and blown out, and the ventilating ducts of the transformers and regulators are thoroughly blown out and cleaned from once to twice a week.

Starting and Synchronizing.

In connection with the operation of such substations, accurate synchronizing is about the most important specific operation required to be performed in a substation. Any serious inaccuracy in performing this operation will result in fracturing the castings of the potential regulator, or if there is no regulator used in connection with the unit, the armature conductors of the converter are likely to be drawn out of their slots or the transformer structure seriously strained.

In connection with the regular shutting down of rotary converters which are normally started from the direct-current end, it is extremely important that the field circuit of the converter should be left closed until the machine stops rotating. This is necessary in order to thoroughly demagnetize the transformer cores and it is partially true in connection with diametrically connected units.

Under certain conditions the converter may stop with the direct-current brushes resting on the commutator bars which are connected to the same armature conductors to which the collector rings are connected, which are in turn connected to the terminals of a given transformer coil. This places this transformer coil in shunt circuit with the armature windings of the converter. If this transformer coil has previously been demagnetized, its impedance will be sufficient, upon throwing the starting current into the armature of the converter, to prevent an undue amount of current from passing through the transformer instead of through the armature of the converter, and the machine will start. However, if the transformer had not previously been demagnetized and the field circuit had been opened at a time when the magnetization of the transformer coil was at a maximum in the same direction as would be caused by the passage of the starting current through the transformer coil, then there would be practically no impedance and the practical equivalent of a short circuit would be connected to the direct-current brushes of the converter, thus rendering it impossible to start the machine. In this case the brushes should be lifted from the alternating-current rings, and the transformer momentarily connected to the high-tension line, thus changing its magnetic state to a more favorable condition.

Starting After a Shut-Down.

In connection with starting up the system after a general shutdown, if the shutdown has been of such long duration as to result in fully discharging the storage batteries, thereby leaving many of the substations without an adequate source of supply for starting from the direct-current end in the regular way, the procedure employed in some of the large systems is to start a large group of converters from a turbine or prime mover, from rest with low-frequency, low-voltage multi-phase currents. The field circuits and direct-current switches of the converters are left open and the unit is connected on the alternating-current side only. A direct-current voltmeter is connected to the direct-current terminals of the machine and as soon as the turbine begins to rotate slowly, slight vibrations of the voltmeter needle will be observed. This action will continue, gradualy increasing in amplitude until the rotary begins to turn. After the converter has made a few complete revolutions the voltmeter needle will have discontinued vibrating, and if the field circuit has not been closed at the proper instant, will have taken up a fixed position either above or below zero, indicating correct or incorrect polarity. The field circuit should be closed as the needle is swinging past zero in the direction of correct polarity, thus locking the converter into synchronism with the generator and insuring correct polarity if the operator is skilful in performing the operation.

The power factor is adjusted to unity by means of the field rheostat, and as soon as the converter potential is equal to the system potential, the direct-current switches of the converters are closed and other converters are started from the direct-current side. They are then synchronized with the low-voltage, low-frequency line, and other generators are synchronized under similar conditions at the power house. Another stage of acceleration then takes place, and this action is repeated until the entire system load has been raised to the normal direct-current potential.

In our operating practice covering this emergency procedure, machines of a rated capacity of 11,000 kilowatts have been thus started from rest, and machines of additional capacity of 7,500 kilowatts were immediately started, receiving direct current from them, after which they were synchronized with the low-voltage, low-frequency lines. Additional machines of a rated capacity of 11,500 kilowatts were thrown onto the line, merely as a drag, making a total of 30,000 kilowatts connected to one turbine when the final stage of acceleration was started. As the turbine used was one of the older units, it is believed that with a new unit of greater capacity a much larger load could be brought up from rest.

In some of these trials the time required to perform all operations from the time the converter started turning until the second converter had been started with direct current received from the first and synchronized and cut in with the low-voltage, low-frequency line, was as low as 30 seconds. The average time, however, is considerably higher.

The time required to start machines from direct current and under regular conditions ranges from about 51 seconds for a 500-kilowatt machine to about 1½ minutes with a 1,000-kilowatt machine, not including time required for regular operation. It is not often necessary to operate the regulator after a shutdown, but in case it should become so, under extreme conditions necessitating running from the neutral point, the time for a 500-kilowatt machine would be about 1 minute and 50 seconds, and for a 1,000-kilowatt converter about 2 minutes and 27 seconds.

SOME FEATURES OF CONDENSER INSTALLATION AND OPERATION.

As a result of the prominence attained by the steam turbine in the steam power installations and also on account of its use in larger types of reciprocating engines, the question of the correct design and installation of condensing apparatus has, of course, been closely studied by engineers.

Condenser installations require great care in design, if they are to meet the actual conditions existing at the place where the condensing apparatus is to be installed, and consequently power users who contemplate putting in condensers, should make a close study of these local conditions. If they are not themselves fully qualified to pass upon the subject, it is advisable for them to consult an engineer who thoroughly understands condenser applications. The matter is too important to hazard a guess, for there is nothing about a plant which can cause more annoyance than a poorly designed condenser installation. For example:

The greatest care is necessary in the design, construction and maintenance to keep the system free from air leakage; for the chief difficulty in maintaining a vacuum arises from such leakage. The leaks are inward, therefore invisible and hard to locate. The designer or the constructor often does not realize all that is here implied, judging from the results sometimes produced.

There are, in addition, a number of points to be observed, which, if carefully followed, will save an endless amount of trouble and lead to substantial economy in the operation of the plant.

The application of two or three coats of elastic paint on clean surfaces will eliminate many of the leaks in the exhaust pipe lines, but there still remain several places for air leaks which are not so easy to remedy. The stuffing boxes on the rods and exhaust valve stems of the low pressure cylinder are apt to be sources of trouble. This, however, can easily be eliminated by using double metallic packing on both rods and valve stems, and piping the steam from the receiver to the space between the two sets of packing, thereby forming a steam seal on the rod. With such a seal it is impossible for air to leak into the system through the stuffing boxes.

Another source of air leakage into the condensing system is through the water supply. The stuffing boxes on the pump should always be sealed with water, and all joints on the suction line must be made up tight. The line should be carefully painted before burying it in the ground. The higher the suction lift, the more care should be exercised in this work, because all air drawn in through the suction line which is subject to vacuum is discharged directly into the condenser. The fact that the pipe may be buried several feet under ground does not protect it from air leakage.

A further source of air being drawn into the condensing system is with the water through the suction line of the pump. All suction lines should be submerged not less than six feet and more if possible. The end of the suction pipe should be increased to at least twice the diameter of the pipe to reduce the velocity of the water entering the line. In a well 12 feet in diameter, a 12-inch suction line was run to a centrifugal pump. The end of the pipe in the well was submerged 8 feet, but not increased in diameter. It had been observed that dry saw dust, thrown on the surface of the water, was sucked in small eddies down into the suction of the above pump. If saw dust was drawn down, it is clear that air was drawn with it. The amount of air coming down the tail pipe of the barometric condenser, discharging into the hot well, showed plainly that there was air leakage somewhere in the system, but the source of it was not located until the action of the water in the well was discovered by the engineers in charge of the plant. The remedy for this condition was to enlarge the diameter of the suction pipe in the well.

RIVER TO LIGHT PARIS.

$4,000,000 to be Saved by Employing Long-range Water Power.

A colossal scheme of power development is said to be on the point of realization in France. It is proposed to utilize the river Rhone for the development of electricity for the city of Paris. Light, heat and motive power are promised at the cheapest rate in the world.

The originator of the idea is an engineer named Mahl. His plans have the indorsement of the National School of Highways and Bridges, and of the Society of Electrotechnicians. The enterprise is so assured that contracts for the delivery of current in Paris at an early day are already being negotiated.

The water is to be drawn from the Rhone at Grezin, not far from the famous Porte du Rhone or falls of Bellegarde, where the river, already of great volume, draining as it does Lake Geneva, plunges for 300 yards or thereabouts through a chasm which it has scored for itself in the solid rock.

The water diverted through a sluiceway will be impounded to the amount of 2,000,000 cubic meters, or about 2,666,000 cubic yards, on the level of Collonges and returned to the river through a double tunnel of 4,500 meters, or about 4,750 yards, with a fall of 65 meters. This will furnish a flow, it is calculated, equivalent to 100,000 horsepower.

The electric current is to be developed by 48 dynamos divided into groups, each driven by a turbine of 10,000 horsepower. The lines to Paris will be as direct as possible; the distance is between 250 and 300 miles; but no special difficulties are expected. Some long lines of delivery in America and one in Sweden, supplying Stockholm from a distance of 600 kilometers, or 360 miles, have been studied in the preparation of the plans, and are quoted as showing that the enterprise is entirely possible.

It is calculated that the delivery of the net electric power from these works in Paris as compared with the development of the same energy on the spot by coal consumption will effect a net annual economy of about 20,000,000 francs, or $4,000,000.

ELECTRICAL COOKING DEVICES EXHIBITED BY GENERAL ELCTRIC COMPANY AT THE CHICAGO ELECTRICAL SHOW.

Last year the Chicago public witnessed the first elaborate public display of devices for cooking and heating by electricity. This year the display is much larger and more elaborate; particularly does the General Electric Company cover the ground in a comprehensive manner. It is perhaps unnecessary in these columns to enumerate all of the devices now being regularly offered to the public for the use of electricity in heating and cooking. Particular attention has been devoted by this company to demonstrating the indestructibility of its cooking devices.

The public is, of course, always attracted by any exhibit where things are cooked and distributed free, but the keen interest shown in the devices themselves is something of an indication of the popular demand for such things.

The electric percolators, chafing dishes, flat irons, and cereal cookers have assumed the dignity of a standard product, but there is a vast growing demand for ovens, broilers, frying pans, and corn poppers, as well as electrical heaters of various sizes designed especially for home and office use. The uses of all these and more are regularly demonstrated at the General Electric Company's exhibit at the Chicago Electrical show.

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EASTERN AGENCIES

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ST. LOUIS .....

WESTERN AGENCIES

LOS ANGELES .....
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Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," with which is incorporated "The Engineers', Architects' and Builders' News."
Entered as second-class matter at the San Francisco Post Office, August 15, 1899.
Entered as "The Electrical Journal," July, 1895.
Entry changed to "The Journal of Electricity," September, 1895.

VOL. XVIII JAN. 19, 1907 No. 3

EDITORIAL.

University Training and the Engineering Profession

Great changes have been made during the last ten years in the arrangement of the technical courses in our leading engineering institutions. Formerly the student was given practically no option in the choice of studies for each year. He found it necessary to pursue the work as given in the course of instruction leading to the degree he desired to obtain, and considered himself fortunate if by passing up a study or taking extra hours he could find a small amount of time to devote to some subject in which he was especially interested. At the present time, however, in most of our engineering colleges it is possible for the student to select as he desires the particular courses which interest him most. This is especially true of the last two years of the regular four years' course. It is, however, quite important that the first two years of the university work shall consist of fundamental or foundation courses which are not only a necessary preparation for the last two years, but have a distinct value in training the mind of the student.

Many young men are ill prepared upon entering the university to wisely select the courses best suited to their needs. There is no doubt that the system which is in vogue at the present time of making the first two years' work rigid as regards the courses which the student may take, considering the requirements of admission and the vast amount of ground to be covered before one may enter what is termed professional work proper, has been a decided advantage to many students. By having their courses of study planned by those who have had much experience in choosing the subjects necessary to fit a student for actual practice of a profession, much valuable time has been saved.

There are two sides to this question of definitely prescribed courses. In following out a rigid course of a study, the fact that a certain result has to be obtained is often lost sight of by the student. He is compelled to take the subjects because they are in the course of study and therefore gives little thought to the training that each is meant to give. If unfortunately he has imbibed the thought of practical ideas from some unknown influence, everything theoretical appears to him as useless, and as a result perhaps the very thing which he will need most in future life is lost. This might not have happened had the student been led to choose the subjects himself, having had the advantage to be gained from pursuing a certain course clearly pointed out by an experienced advisor.

The practical fever in many instances destroys the very influence that tends to place the college bred, professional man in the long run ahead of his more experienced practical brother who has worked himself up by successive promotions in some trade or profession. Any one of average ability, by steady application and strict attention to duty, may become a first-class foreman or superintendent without investing, what would be a small fortune to a young man beginning life, in a college education. If this is the end in view, by all means let the young man invest his money in some steadily growing company. A few thousand dollars' worth of stock will obtain for him more practical use than the same amount invested in a college education. But it is to be hoped that this is not the end which most students have in view. Only the thoroughly trained, conscientious, high idealed man can be an investigator, a successful inventor or a master in his profession.

The development of masters is what a college education is for. The master of a profession must not only know how to apply the theory he has studied to obtain the desired practical results, but what is much more important, he must be able to evolve new theories by studying and analyzing practical results, which theories will lead to new conclusions, thereby obtaining more and more control of the natural forces with which he is surrounded. In the last two years of the university work, the courses should be surrounded by the right influences and the personality of the instructors should be such as to indicate to the student the training each portion of the course is meant to give, and to impress the fact upon the student's mind that no one subject but all are the most important. This spirit prevailing throughout all the courses would harmonize all the departments of the university and do much to surround the student with the influences that do so much to form the best education.

BOOK REVIEWS.

The British Institution of Electrical Engineers has issued Part 12 of its Science Abstracts for the year.

These publications, published monthly, are devoted to short abstracts of all important scientific and engineering articles appearing in the technical press of the world.

The names of authors and publication in which they appear are also given.

The Co-operative Electrical Development Association have issued in attractive pamphlet form, the article by Charles Nathan Jackson on the "Organization and Conduct of a New Business Department, Suitable for Central Stations in Cities of 50,000 Population and Under."

This article received first honorable mention by the above association, and was of such merit that it was published in full in a recent issue of the "Journal."

"Self-Propelled Vehicles," a practical treatise on all forms of automobiles, by James E. Homans, A. M. Fifth revised edition, entirely rewritten. New York. Theo. Andel & Co., 63 Fifth Ave. 1907.

In this revision of previous editions the above book fulfills the requirements of the motor vehicle owner, operator and repairer. The author has emphasized the practical aspects of motor vehicles of all powers, confining his space to the discussion of matters fundamental in construction and management. Theoretical matters, which are important only in a general sense to designers and builders, are introduced only where good explanations positively require them. All subjects are fully illustrated, and its standard as regards paper, type work and binding is very high.

TRADE CATALOUGES.

The Holtzer-Cabot Electric Co., of Boston (Brookline), Mass., have sent out several small leaflets descriptive of their electric apparatus. They apply to motors for alternating and direct current, and to motor generator sets of small size.

The electrical department of Allis-Chalmers has issued revised Bulletin No. 1045, relating to rotary converters. The illustrations are up to the usual Allis-Chalmers standard, and the descriptions of various parts complete and to the point.

General Electric Co.

Descriptive bulletins on following appliances have been recently issued by the General Electric Co. Supply department:

No. 4469—Pocket Instruments for Direct or Alternating Current, supersedes No. 4378.

No. 4472—Mercury Arc Rectifiers supersedes No. 4411.

No. 4477—Accessible Manhole Junction Boxes, Type SD, supersedes No. 4326.

No. 4474—G. E. 76 Railway Motor.

No. 4476—Type PP Dial Controllers.

No. 4478—Parts of Type K Series Parallel Controllers, supersedes No. 7560.

No. 4479—The Toledo & Chicago Interurban Single-phase Railway.

No. 4480—Pipe Thawing Transformers.

No. 4483—General Electric Automatic Time Switch, Type T, for Alternating and Direct-current Circuits.

Electrical Instruments.

The Wagner Electric Mfg. Co., of St. Louis, have issued a catalogue relating to a complete line of electrical instruments. Considerable space is devoted to the general principle of operation and construction of the various types which are at the present time in general use.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The 213th meeting of the American Institute of Electrical Engineers will be held in the Auditorium of the Engineers' Building, 33 West Thirty-ninth Street, New York City, on Friday, January 25, 1907, at 8:15 p. m. The following paper will be presented by Lewis B. Stilwell and Henry St. Clair Putnam: "Substitution of the Electric Motor for the Steam Locomotive." The paper will include:

1. Presentation of certain facts established by experience in the operation of elevated, subway and interurban lines by electricity.

2. Discussion of comparative cost of operation by steam and electricity applied to railways in operation, and including both passenger and freight service.

3. The importance of standardizing electric railway practice.

4. The question of frequency in the operation of railways by alternating current.

Members of the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the New York Railroad Club and the Transportation Club are cordially invited to attend this meeting.

THE UNITED STATES LARGEST CONSUMER OF RUBBER.

With about $50,000,000 worth of rubber imported into the United States last year, this country has become the consumer of more than one-half of the rubber crop of the world, according to the Department of Commerce and Labor. The popularity of the bicycle and the automobile, coupled with the increased use of electricity in the daily affairs of the people, are responsible for the increase, the department experts say. Brazil is the chief contributor to the supply for the United States, but the growing demand, together with the reckless manner of collection in South American forests, has led to the establishment of rubber plantations in India, Ceylon and even in the Philippine Islands. Indications are that the rubber-growing industry in the Philippines and in the Hawaiian Islands will become very profitable.

FUEL TESTS.

As evidence of the co-operation between theory and practice which happily exists in the United States we may mention that a series of investigations of great interest to manufacturers and coal exporters is to be undertaken at the State experimental station which has been quite recently established at the University of Illinois. It has been arranged that a rather elaborate series of experiments with various Illinois coals should be run so as to determine the most economical method of using them. For this purpose tests will be made on the fuel under boilers for power plants, in gas producers, in heating boilers; and there will also be made chemical and calorific tests. In the State of Illinois there has of recent years been a great advancement due to the development of its natural mineral resources and also to the exceptional facilities for transportation. Several of the leading engineering socities were asked to co-operate with the State Geological Survey and the University departments of applied chemistry and mechanical engineering. A preliminary conference was recently held and arrangements were made for the tests to be carried out.

HOW A GAS MAN MAY SHARE THE SUCCESS OF HIS COMPANY.*

By Charles S. Ritter.

I refer to any employee of a gas company, but particularly to the man who is already an executive; the manager or any one of his assistants.

This topic is almost self-evident, because the gas man usually does share the prosperity of his company. Good men are too scarce and too much sought, for it to be otherwise. It is not, however, of the man who can better his position by changing, but the one who can make his position better by staying by it, that I wish to speak.

Some of us, perhaps, are looking forward to changing as a means of widening our experience and amplifying our education. The superintendent in a small plant believes opportunities are better in a large one, and the assistant in a large plant wants to be superintendent in a smaller one for the same reason.

When the superintendent of a small plant goes to a large one, the first thing that impresses him is the narrowness of his field for observation and experience. He is held down by a multitude of duties in his own department, and if he attempts to go beyond he is likely to tread on the toes of a brother superintendent. On the other hand, the assistant in a large plant, who leaves to become superintendent or general manager in a smaller one, can see at once a limit to his income, because of the restricted earning power of a small plant. There is this much to say, however, in favor of the small plant—it is practically the only place to get an all-around education in the elements of the business—it is the best school.

It is prudent for the man to consider carefully the prospects in his present position before making a change, and whether he has developed them to their highest potential. I have known gas men to study hard on some subject out of their own department, or foreign to their business, in a vain endeavor to better their condition, in the meantime allowing subordinate associates to be promoted ahead of them because of lack of application and appreciation of possibilities in their present situation.

In a growing city it is very likely the gas man will get the most out of his business by remaining with his present company and growing up with it, not in immediate financial benefits, perhaps, but in ultimate net results, social and financial.

If I were the owner of a gas company I should try to get men whom I could trust to interest themselves in building up a strong and safe institution and who would look forward to remaining with it and sharing in its success, both as a matter of personal pride, and because it would yield them ample profit.

There can be no greater incentive in promoting the company's welfare than to give them a wide latitude in which to apply their own methods. One is bound to make his own plans work, and although the plans themselves may be somewhat inferior, they will succeed better if vigorously pursued than though they were originally very good but poorly executed. No compensation is greater for a man than to watch his own plans succeed.

The gas man who looks forward to making a change may work selfishly for the largest immediate profit or smallest expense account he can show, for use later to advertise himself. He may adopt methods that will incumber his plant with unjustified construction charges in order to secure for himself the greatest benefits. His attention being concentrated upon making a record quickly may cause him to neglect proper analysis of construction expenditures, and repair the depreciation accounts. The load he will eventually pile up on the plant account would be left for his successors to worry about.

As it is with the chief executive, so it will be with his superintendents and their assistants, and all of the other employees under them. Incidentally, the selfishness of the management will be noticed by the employees and imitated by them. In some form or other they will also have their own personal graft; "like master, like man."

There are certain elements in the gas business that are purely local and peculiar to each individual plant. They probably constitute the largest and most important portion of the gas man's education, and the gas man who stays with his company should be compensated for this knowledge. It is the theory upon which we justify an advance in salary for length of service.

There are no two gas companies exactly alike. The man who knows the most about a company and its peculiarities and environment ought to be the man who has grown up with it. There is certain knowledge that is not a matter of record; it is very subtle and defies definition. It is the result of:

1. A good understanding of the political and social life of a city—a very valuable asset and one that cannot be absorbed in a short time.

2. The man's personality; I believe it is as valuable as all of his specific knowledge of the business put together, both in the internal management of the company and the influence on the public. By long association only, can the gas man acquire the confidence of his associates and the public. He will know all of the leading citizens of his town; not only in a business way, but socially also, and will be able to place the correct estimate on them when brought in contact with them. Such knowledge and confidence is cumulative; it is acquired slowly and cannot be accurately obtained except by long association and patient effort.

"Efficiency and permanence of labor" is susceptible to greater improvement than any other factor of our business, and is dependent largely on permanent management. When a manager remains with his company, his assistants are very apt to do so, and they in turn hold the other employees. The employees of a company form an almost endless chain, reaching practically every social and business circle in the city. If they are intelligent, of good moral repute and good address, the impression given the public will be good. If they are not, and changes are frequently made, the impression will not only be bad, but the company will be subject to slander by those who leave. An employee rarely leaves a company without carrying with him more or less ill feeling toward it, and there is no telling how much lying he will do to cover up the real reason for his departure, or as a matter of spite, to get even.

It is a very disagreeable fact that the statements of disgruntled employees are usually regarded as more truthful than the contradictory ones made by the officers of the company. The statement of a discharged bookkeeper might require the combined efforts of the general manager and board of directors to refute it, and possibly an examination of the company's books by a set of experts. Even then there will be a few skeptics ready to discredit the experts' statements, believing that they were bought by the company. This is one reason for retaining a permanent organization. Another good one is that changes always bring about more or less internal as well as political disorder.

A gas man leaving a plant nearly always takes one or more of its employees with him to his new field. The new man naturally starts a small panic of resentment among the old employees, some of whom naturally expected promotions.

Of course there is a lot to say in favor of the "outsider." If a vacancy occurs or a place is to be filled, and no one on hand big enough to fill it, there is nothing to do but bring in an "outsider." To be sure, it is preferable to promote a man from the ranks, provided an exceptional man is available, but when such a one is not and a good man is needed, the "outsider" is inevitable. An occasional "outsider" is

*Paper read before the Michigan Gas Association, Sept. 19, 1906.

good for a company, and good for the employees, too; it prevents stagnation.

I have digressed somewhat from the subject in considering "why it is best for a company to retain an employee," and I offer as an excuse, that the employee cannot be considered without the company. Whatever benefits the company will (or it should) also benefit the employee. If the employee believes he is not receiving fair treatment, he should get out and go where he can. Then, too, the company should get rid of the "peace disturber"; pruning is as necessary to organization to keep it healthy, as it is to trees. One disgruntled grumbler will often infect the whole organization with the "fever of discontent." The gas man must be loyal to the company that pays him a salary. Then, and only then, can he hope to share its prosperity.

Briefly: If he remains with his company, is loyal to it and works for its owners as he would if owned by himself, his greatest satisfaction will be the knowledge that his methods have succeeded and that he has acquired the admiration and esteem of his chief executive, as well as of the other employees and the consumers. If the company is successful through his efforts he will participate in its success; his compensation will be well taken care of; trust the president and board of directors for that.

HISTORY OF THE CO-OPERATIVE ELECTRICAL DEVELOPMENT ASSOCIATION.

A few years ago the interest in electric power stations lay mainly in their development from a purely engineering point of view, but it is only necessary to glance at the technical journals of the present day to recognize the consideration and thought which are now given to the business-getting departments of central stations, and to the commercial introduction of electrical appliances.

One of the greatest factors in bringing about this change is the aggressive activity of the Co-operative Electrical Development Association, which, though still in its infancy, has accomplished a great deal toward promoting the interests of the electrical business. The history of this association was brought out at the joint meeting of the electrical trades, held in New York on December 13th, to discuss ways and means of organizing this co-operative association on a permanent basis.

The idea of co-operative action affecting an electrical industry originated with the Incandescent Lamp Manufacturers in February, 1905, their purpose being to secure the co-operation of the distributing trade to encourage the use of incandescent lamps. An appropriation of $10,000 was then made to put the initial plans into effect.

Further consideration of the subject led to the logical conclusion that it would be a mistake to confine the activity of such a movement to the lighting end of the business since a high all-day efficiency of power plants depended on the sale of electric power for heating and motive purposes.

It was also recognized that the distributing trade would be more actively interested in a movement which had for its object the promotion of the electrical business as a whole rather than of a particular class of products exploited by a limited number of manufacturers.

A paper was read before the National Electric Light Association at Denver in June, 1905, advocating this broader scheme of co-operation, and the Association appointed a committee of three central station managers to co-operate in the development of the work.

This broader proposition was taken up by the Incandescent Lamp Manufacturers on February 7, 1906, and was unanimously endorsed. It was decided to make an appropriation of one-fifth of one per cent of the aggregate sales of the various members for a period of three years, to be used in furthering this movement.

On March 23rd following, a joint meeting of the electrical trades was held in New York to consider the matter. A resolution was passed expressing confidence in the practicability of the movement and in its promise of producing highly profitable returns. A committee was appointed to formulate a practical scheme of organization and, when a sufficient number of business concerns had agreed to co-operate in the work, this committee was to be authorized to take such steps as were necessary to make the organization an effective one.

The members of the National Electric Light Association, at the convention held in Atlantic City in June, 1906, evidenced the keenest interest in this proposition, which received the unqualified endorsement of the Co-operating Committee appointed at the Denver meeting. President Williams of the Association appointed a committee of five central station managers to work together in behalf of this movement. At the joint meeting of the electrical trades held on December 13th, committees were appointed to report on such matters as are preliminary to effecting a final organization, which, it is hoped, will be possible at the next meeting.

From May, 1905, to November 30, 1906, the Association expended $28,256.41, principally in the issuing and circulation of advertising matter. The Association estimates that the publicity obtained through the hearty co-operation of the technical press and newspapers, was equivalent to an additional expenditure of $60,000. The results so far attained are very gratifying, assuring the practicability of a movement which promises large returns in the future.

DIRECTOR OF WORKS APPOINTED FOR THE ALASKA-YUKON-PACIFIC EXPOSITION AT SEATTLE.

Frank P. Allen, Jr., an architect and engineer of wide experience, has been appointed director of works of the Alaska-Yukon-Pacific Exposition which will be held at Seattle during the summer of 1909. It is his duty to supervise all work done on the grounds, and after the Exposition opens to have charge of the maintenance of the grounds and buildings.

Mr. Allen gained his exposition experience at the Lewis and Clark Exposition at Portland in 1905, where he had charge of the structural work. Mr. Allen was born in Grand Rapids, Michigan. He secured his early training in his profession under his father, Frank P. Allen, Sr., who was a prominent architect. After taking a course in civil engineering at the University of Michigan he went to Chicago where he spent six years, specializing on structural work for bridges, railroads and large buildings. At Portland he became a member of the firm of Lewis & Allen, consulting and construction architects and engineers. He is manager of the General Engineering and Construction Company, of Seattle and Portland.

The Exposition grounds cover 250 acres of the unused portion of the campus of the University of Washington, and border for more than a mile and a half on Lake Washington and Lake Union. The site has been pronounced by John C. Olmsted, the famous landscape artist, who laid out the grounds, as the most beautiful ever utilized for such a purpose. Mt. Rainier and Mt. Baker, with their perpetual snow peaks, are in plain view. Twelve large exhibit palaces will form the nucleus of the Exposition. Work on the grounds has already begun under the direction of Mr. Allen.

It is estimated that Cape Colony required in 1905 an average of 281,100 electrical horsepower, and it is, therefore, no wonder that British capitalists are as anxious to harness the natural energy of the Victoria Falls as Americans are to completely utilize the waters of Niagara.

INDUSTRIAL

IMPROVED MOTOR-DRIVEN POLISHERS AND GRINDERS.

The illustration shows the larger sizes of grinders manufactured by Roth Bros. & Co., Chicago.

One of their distinctive features is the short distance between the front of the motor casing and the shaft. This permits long pieces to be worked with the utmost ease. With the ordinary construction, where the shaft projects from the center of the casing, it is necessary to work on the corners of the wheels because the work strikes. Not only is the amount of work which can be done considerably less, but the life of the wheel is shortened. The removal of this fault marks a great step in advance.

Another distinctive feature is the ribs with which the motor casing is covered. The surface available for radiation of heat is increased about three times. The amount of hard work and overload which the motor will stand is increased the same amount and, besides, cool running is assured under normal conditions.

The pedestal base contains the switch, starter and field regulator. The speed can be adjusted to suit the decreasing diameter of wheel as it wears down. When the regulator is adjusted to a certain speed that speed is maintained almost constant, no matter how hard the grinding.

Some other good points are: Bearings adjustable for end play; crucible steel shafts; removable shafts; heavy bases preventing vibration; really dust-proof covers, etc.

These distinctive features go to make up a grinder which has proven to be unexcelled.

A MODERN PLATE GLASS PLANT.

The Crystal City Plant of the Pittsburg Plate Glass Company is now about completed at Crystal City, Mo., 28 miles below St. Louis. There are 15 buildings, all of reinforced concrete. It is estimated that 50,000 barrels of cement will be used in the building process, the brand being the "Universal Portland," made in the cement division of the U. S. Steel Corporation. Even the roofs are to be reinforced concrete tile, 4 feet by 8 feet.

In the equipment of this huge plant, due provision has been made for adopting the most modern methods of manufacture. Among industrial plants of its kind, this establishment is unique as being one of the largest in the country, and also as being remarkable because of the unusual size of the power and lighting units installed there. The machinery will be driven by electric motors of exceptional size. The power equipment already contracted for includes an 1,800-B. horsepower gas engine, direct connected to a 1,000-kilowatt generator.

This unit will be installed in the same power house with a 5,000-horsepower Allis-Chalmers engine, famous as the "Big Reliable." This engine carried the entire lighting load for the illuminating of buildings and grounds of the Louisiana Purchase Exposition at St. Louis. The name was given it by the attendants because of continued good service during the entire duration of the Fair.

Sixteen hundred horsepower in Allis-Chalmers induction motors will be used to drive grinders and polishers.

The Tracy Engineering Co. has just received nearly a carload of foundation bolts for a large number of Nordberg-Corliss engines and compressors recently sold to the Selby Smelting Company for their San Bruno plant.

COMPLETE ELECTRICAL EQUIPMENT FOR A SAWMILL.

The Great Southern Lumber Company has decided to install a complete electrical equipment in its new mills at Bogalusa, Louisiana. The company controls various properties in different lumber centers, and the new mill will be not only the largest in the United States, but also will have the most complete electrical equipment. As a result of this latest industrial center a new town is being built within the confines of the old, which before had not even a postoffice.

The electrical equipment will be furnished by the General Electric Company, individual induction motor drives being used on all of the machines, the total motor equipment aggregating some 2,400 horsepower. The induction motor has been found particularly serviceable for this class of work, and being so simple that it is often compared to a piece of shafting revolving between two hangers, little attention is required. Having neither commutator nor brushes, there is no sparking, therefore this type of motor will operate without fire risk, in the dust or shavings, incidental to sawmill work.

At the new mill, the generating equipment will comprise three generating units, direct connected to steam engines. Two of these units have 500-kilowatt (about 750 horsepower) electrical generators, while the third unit will be smaller capacity, generating about 300 electrical horsepower. All three units will be of the General Electric, three-phase, revolving field type, running at 100 revolutions per minute and generating current at a potential of 2,300 volts, and a frequency of 60 cycles. The power house will also contain two direct-connected marine generating units, each consisting of a 30-kilowatt generator, driving at 305 revolutions per minute by a direct-connected vertical engine. These machines will supply direct current at 125 volts for exciting the fields of the generators. A complete switchboard will also form a part of the power plant equipment.

From the power house the current will be transmitted to small transformer stations outside of each building; here the voltage will be "stepped down" from 2,300 volts to 440 volts for operating the motors at the individual machines. This use of alternating current for operating the motors permits considerable saving in the transmission system. The motor connections to the transformer stations will be made by means of cables insulated with varnished cambric and laid in unlined steel conduit.

H. W. Johns-Manville Co. have sent out an attractive little circular giving a "practical demonstration" which shows why the J. M. Giant Strain Insulator has proven so successful. Suitable for circuit up to 5,000 volts.

A ONE HUNDRED AND FIFTY THOUSAND-VOLT TRANSMISSION LINE.

To American engineers, especially in California, where the transmission of electrical energy has reached a high state of development, the project of the British South Africa Company to build a transmission line 600 miles long, will seem utterly impracticable in the light of the many difficulties to be overcome. This company proposes to generate electric power at the Victoria Falls in Rhodesia, and transmit it to the Witwatersrand, which has long been known as one of the richest gold-mining districts in the world.

The Victoria Falls is a gigantic cataract on the Zambesi River, about 600 miles northwest of Johannesburg. As a scenic spectacle these falls rival the Niagara Falls in their beauty and majesty, and are very popular with tourists traveling in Africa. The Zambesi River, just below its confluence with the Kuanda, is divided by three small islands into four streams which suddenly plunge over a vertical precipice into a chasm from 100 to 300 feet across. The two easterly falls are almost dry in summer, but the main fall, which is centrally situated, is 300 feet wide and 400 feet high.

According to the present plans the water turbine station will be built at the bottom of the gorge, just beyond a sharp bend, so as not to interfere with the natural scenery of the falls. It is proposed to generate initially 50,000 horsepower, and to operate the plant at its maximum capacity irrespective of the magnitude of the load.

A pumping station is to be built on the Crocodile River about 500 miles from the falls and 100 miles from Johannesburg. There will be installed motor-driven pumps which, during periods of light loads, will be operated by the surplus power from the turbine station to store water in a large reservoir to be built on the adjacent hills. During periods of maximum demand auxiliary dynamos will be operated by this supply of stored-up energy to regenerate electric power.

Without such a scheme of alternate storage and regeneration much of the kinetic energy of the swiftly moving water at the falls would be wasted when the power demand is light, as it commonly is in hydraulic plants in California. This arrangement also permits the plant to be operated continuously at full load, which results in a high efficiency with a corresponding increase in the earning power of the investment.

To guard against interruptions of the system by shutdowns or other contingencies, an auxiliary steam plant will be built about 100 miles from Johannesburg, to have a capacity of 20,000 horsepower.

To economically transmit electric power for a distance of 600 miles in accordance with current practice, requires that the line voltage shall be greatly increased over that now employed. In spite of the fact that a line pressure of 60,000 volts is generally considered at the present time as the maximum voltage which can be employed with an assurance of safety and reliability, the engineering experts of the company seem to have great faith in their ability to solve the difficult problems involved in the construction of a 150,000-volt transmission line. Their plans for insulating the conductors on the cross-arms and securing good voltage regulation besides controlling the excessive charging current produced by the capacity of a 600-mile line, have not been made public. It has, however, been decided to use aluminum cables for the conductors. These will be carried on steel towers sixty feet high.

The Platt Iron Works, through its San Francisco manager, Mr. E. Dewald, has closed a contract with the Exchequer Gold Mining Company for a 600-horsepower water wheel to drive the generators and air compressors on the latter company's property. Messrs. Hunt, Dillman, Meredith and Allen were the consulting engineers.

News Notes

ELECTRIC RAILWAYS.

Cheney, Wash.—Eslick & Carpenter, contractors on the Spokane Interurban, have opened headquarters at this place.

Eugene, Ore.—The Willamette Valley Company took out a water right which will use 80,000 miners' inches, and it is their purpose to use the power thus developed in carrying on an electric line from Eugene to Blue River.

Lewiston, Ida.—Two surveying crews were sent out on the proposed route of the Lewiston & Southeastern electric road between this city and Grangeville.

Helena, Mont.—The Helena Light & Railway Co. will change and improve its car tracks.

North Yakima, Wash.—Representing Frederick Elmendorf, of Spokane, T. A. Noble filed an application with the county commissioners for an electric railway franchise to the Mexee Valley, and then southwesterly through Union Gap to a point below the intake of the Sunnyside canal.

Spokane, Wash.—Sealed bids will be received at the office of the Oconagon Electric Ry. Co., 408 Empire Bldg., until Feb. 6, for furnishing 60,000 railroad ties.

Seattle, Wash.—Mayor Moore signed the ordinance granting to M. J. Wightman and C. E. Muckler a franchise for a right of way through the city.

South Bend, Wash.—A franchise has been granted by county commissioners to M. C. Welsh for the building of an electric railway between South Bend and Raymond.

Seattle, Wash.—The Seattle Electric Company is making rapid progress on the line to and through West Seattle. From Youngstown the track has been laid for two miles.

Turlock.—Mr. Irwin reports that if the weather permits, the grading on the Irwin City and Southwestern electric line will commence at once. The rights of way have all been secured and all papers signed up except with two parties, and soon these will have been signed. Mr. Irwin states that he expects to be able to have cars running into Irwin City in sixty days after starting on the grade at this end of the line.

Chico.—The Northern Electric Company has enroute from the factories in the East the greater part of a consignment of 200 flat cars which will be added to its rolling stock on its lines between Chico, Oroville and Marysville and other lines soon to be constructed. Some time ago an order was sent to different factories and car shops in the East for 200 flats and ten or fifteen of these have already been received here. The rest of the order is now on the way in small numbers. The cars are of 80,000 pounds capacity each and of the regular build and pattern.

Los Angeles.—It is stated that the Los Angeles Pacific Railway Company has closed deals for the purchase of Nob Hill, the miniature mountain at Playa del Rey, and proposes to tearing it down and use the earth for filling in the low swampy ground in the vicinity. The company proposes to expend many thousand dollars in improvements there in the near future.

Fairfield.—The Supervisors have extended the Hartzell electric road franchises on a number of roads in the county for six months. Grading has just begun on the proposed road from Benicia to Vallejo.

San Diego.—H. E. Huntington of Los Angeles has applied for a railroad franchise which is intended to be one of the links in a railway line soon to be constructed between Los Angeles and San Diego.

Los Angeles.—Sealed bids will be received by the city clerk for a franchise for an electric railroad upon certain streets in Los Angeles. The Railroad will begin at the intersection of W. First with Hill street, along Hill, passing through the tunnel to be built by the city between W. First and Temple streets to the northerly line of Temple.

TELEPHONES AND TELEGRAPH.

Blackfoot, Mont.—The R. M. Telephone Co. has moved its offices into their new building.

Grangeville, Ida.—C. McDaniels, manager of the Buffalo Hump Tel. Co., is building a telephone line from Concord to Oro Grand.

Helix, Ore.—The Farmers' Tel. line has decided to connect with the Pacific States line.

Nampa, Ida.—Messrs. Beveridge and Leonard, of the Western Electric Co. of Chicago, are here to install the switchboard at the local telephone exchange.

It is stated that the Sunset Telephone Company contemplates stringing six wires from San Francisco to Manhattan, Goldfield and Tonopah. These wires will pass through Reno and Sacramento and will greatly increase the efficiency of the telephone service between these cities. It is estimated that the cost of stringing these wires will be more than $500,000.

Spokane, Wash.—M. A. Phelps, president of the Interstate Telephone Company, announces that the lines will be extended into the Coeur d'Alene mining district in Northern Idaho, the total cost of the improvement to amount to $125,000. It is purposed to reach all the towns in the mining district and other points in Idaho, making 450 miles, work beginning early next spring. The company has just taken out a mortgage for $500,000 in favor of the Spokane & Eastern Trust Company, for 20 years at 6 per cent. The plant at Sandpoint has been enlarged, the improvements consisting of a double switchboard and a number of cables, also a second copper circuit from Sandpoint to Laclede, 16 miles, and a second circuit from Rathdrum to Athol.

ILLUMINATION.

Selma.—The Selma Light and Water Company is to pass into the hands of the San Joaquin Light and Power Company, and an entirely new system will be laid to all parts of the town, and the service made as complete as possible.

Pasadena, Cal.—A contract for the concrete foundation work for the building to house the new electric lighting plant has been awarded to Ellsworth & Co., of this city for $1370. The contract for item No. 2 in the notice for bids, being for a steam pumping head and draw valve pump cylinder, was not awarded, although bids were received. These bids were referred to Manager Glass for further investigation and report. Bids were received from Baker & Hamilton and the S. J. Smith Machinery Company.

The Palms.—Work is to be commenced within ten days on the installation of the electric lighting plant for the Palms.

Needles, Cal.—Ground was broken this week for the construction of the electric power and light plant of the Victor Gold Mining Company.

San Jacinto.—Work on the Hemet-San Jacinto Gas Company's plant is to begin the first of the week and the plant is to be in operation some time in May.

Chico, Cal.—The officials of the Chico Gas & Electric Light Company have perfected plans for a complete change and overhauling of its power and lighting plant in this city. One of the changes to be made is the removal of the sub-station from its present site at the Gas Works at the corner of Second and Cherry streets to the concrete sub-station immediately south of the Northern Electric Carbarns. A pole line will be run from Park Avenue from the new sub-station up Main street.

Bisbee, Ariz.—The Bisbee Improvement Company is taking steps to remodel its electric light plant. Louis R. Fosdick, an expert electrical engineer from New York, is on the ground and will prepare plans and specifications for an up-to-date plant.

INCORPORATIONS.

San Francisco.—Articles of incorporation have been filed for the City Electric Company, which has been formed for general lighting and power purposes. The capital stock is $5,000,000, of which $9000 has been subscribed. The directors are Adolph Mack, J. J. Mack, Henry Steinbach, Mortimer Fleishhacker, Herbert Fleishhacker, W. S. Goodfellow, Charles P. Eells, Frank W. Smith and Walter Arnstein. Mortimer Fleishhacker and other directors of the new company deny that the concern has anything whatever to do with the San Francisco Coke & Gas Company merger, and they declare that the company is entirely independent of any other organization. The machinery for the new plant has been ordered and the promoters say that work on the plant, the site for which will be at some location not yet chosen on the bay shore, will probably begin next week. It is the intention of the company to manufacture all its electricity in San Francisco by the use of oil fuel. Turbine engines, the first to be introduced in San Francisco, will be used for the generation of the electrical current. The company will manufacture electricity for general lighting purposes, and its directors expect to reduce the present cost of the commodity. The plant will have a capacity of 10,000 horsepower.

FINANCIAL.

San Francisco.—Henry Brunner of the Central Trust Company, who has just returned from Paris, where he organized the French-American Bank, says: "A prominent French engineer, who is an expert in railroad and electric power matters, came to the United States with me and is now examining several propositions under my instructions. The financing is to be carried out by a group of French bankers, headed by the French-American Bank, in which a great many French bankers are interested as shareholders and several as directors."

San Francisco.—At the annual meeting of the Spring Valley Water Company, out of 280,000 shares over 167,000 shares were represented by owners or by proxy. The following board of directors was chosen: A. N. Payson, J. M. Quay, Homer L. King, I. W. Hellman, Jr., F. B. Anderson, J. Henry Meyer and M. B. Kellogg. The income of the company now reaches $130,000 a month, an amount sufficient for all claims, operating expenses, taxes and fixed charges of whatever character.

TRANSMISSION.

Red Bluff.—E. W. Sutcliff, who has charge of the construction of the voltage power line, is here to put 150 men to work on the new plant on Battle Creek, which, when completed, will cost $1,500,000. A dam just below the junction of North and South Battle creeks will be built which will be 130 feet high and 800 feet across. The water from the three creeks mentioned will be carried six miles in ditches to a power site on a section of land which this company has purchased from the Central Pacific Railway.

Auburn.—J. E. Russell has taken up the proposition of damming the American river near this city to secure a fall of 200 feet. The watershed embraces 1500 square miles with about 30 small lakes which are dry. The average rainfall varies from 36 at Auburn to over 100 inches at the summit of the Sierras. Mr. Russell declares that the best water power in the State lies unused at this point. The water is fine and soft and could well be supplied to Sacramento and San Francisco for domestic use. At the same time there could be developed from 10,000 to 30,000 horsepower of electrical energy.

Washington.—When the Army bill came up in the House of Representatives, Kahn made a successful plea for the insertion of $30,000 for the repair of the power station at the Presidio.